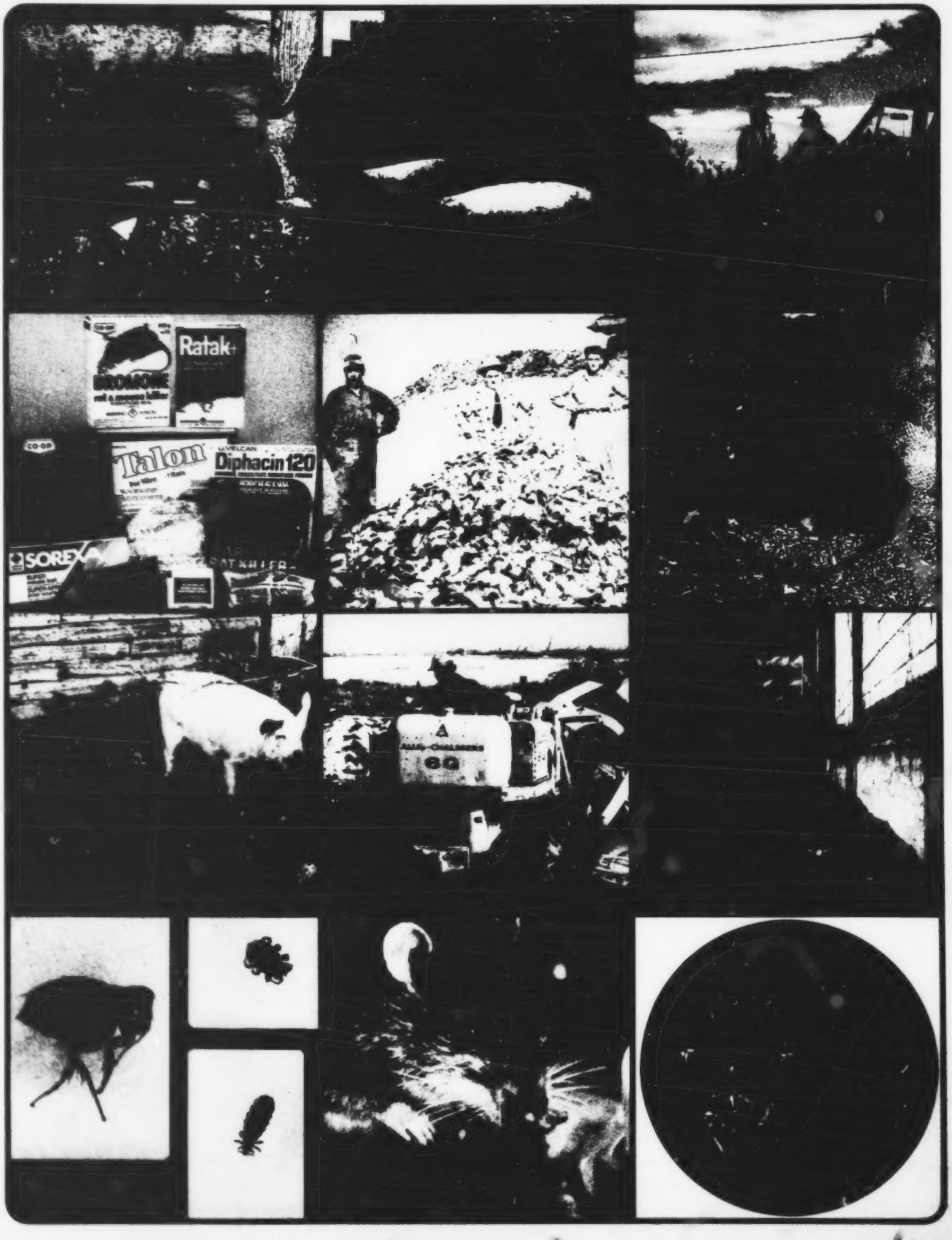
Rat Control on the Prairies



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Rat Control on the Prairies

Prepared by
Dan A. Harvey
Pest Management Specialist
Saskatchewan Agriculture
Regina, Saskatchewan S4S 0B1

Cooperative Agricultural Extension Service Publication

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MANUAL FOR RAT ERADICATION

The information contained in this manual is important, if not critical to successful control of rats. There are already many valuable pamphlets and bulletins available on rat control published in many countries around the world. Most of these however, deal with urban rat control and not with the specific kinds of problems we face on the Canadian prairies.

In this manual, an attempt is made to concentrate on the prevention and control of rats in rural areas and small urban centers.

To eliminate rats altogether, we are faced with 2 problems: (i) controlling the individual rat, and (ii) controlling groups of individuals, or "populations", over a wide area. It is one thing to trap or kill a rat or mouse in the barn, yet quite another to control large numbers of them in a sparsely populated area. Although at any given instant, man may be after a certain rat or mouse, he wants eventually to control rodent populations over large areas.

This manual therefore deals with two distinct subjects:

- the first portion deals with individual rats, their identification, distribution and life history.
- the second deals with the principles of controlling populations over a wide area.

The primary objective of all rat control should be long-lasting relief from the pest problem. The more informed the public and professional pest-control operators are about the principles of rat control, the greater the chances that a program will be successful in achieving this objective.

The methods used in a control program should take into consideration not only the benefits from eliminating rats, but also the risks associated with the hazardous materials being used for rat control. Hazards to domestic animals and other non-target species will be minimized through better informed individuals.

PLANNING A COMMUNITY RAT CONTROL PROGRAM

When planning a rat control operation on an area-wide, or community-wide basis, it is advisable to consider the following points before starting the program:

- First and most important, a uniform administrative organization is required for success. All managers and field staff must work together in a province-wide, coordinated approach.

The Pest Control Officer must be well skilled in public relations.

- All local and other governmental agencies and associations that should be involved must be properly informed and organized. An unfavourable political atmosphere practically guarantees that a control program will fail.
- The problem and corrective measures necessary must be properly defined.
- Priorities should be established with precise objectives for all the various control measures to be undertaken.
- Never become complacent, but constantly seek to improve the program.
- The professional pest control officer (PCO) or fieldman is the backbone of any such program. The PCO must therefore have a high degree of competance with regard to rat control methods.

RESPONSIBILITY OF RAT CONTROL

The basic responsibility of rat control lies with the owner and/or the occupant of the land, dwelling or business.

In Saskatchewan, the Norway rat has been declared a "pest" under provisions in **The Pest Control Act.** The Minister of Agriculture is responsible for this legislation and is empowered to transfer authority for controlling rodents to rural and urban governments. The municipal governments then pass Bylaws requiring every person within each municipality to take all appropriate measures to destroy, control and prevent the spread of rats.

In Alberta, the Norway rat (or other rat or strain derived from the genus **Rattus**) has been declared a pest under the authority of **The Agricultural Pests Act.** Landowners and muncipalities (including urban municipalities) shall take active measures to prevent the establishment of rats on their land and to control and destroy rats on their land or property.

In Manitoba, the municipalities have jurisdiction to declare rats as pests under the authority of **The Municipal Act.** As in Saskatchewan, Bylaws may then be passed by the municipalities which transfer the responsibility for rat control to all residents therein.

THE PROBLEM

RATS ON THE PRAIRIES

The Norway rat (*Rattus norvegicus*), also known as the brown rat, common rat, or sewer rat, is the only species occurring on the Canadian prairies. It is not a native to North America, but is believed to have been introduced by early settlers when their rat infested ships first visited our eastern shores. Like almost every other introduced or exotic animal species, the Norway rat quickly spread and became a serious pest.

Rats followed the westward movement of colonists, reaching the Great Lakes during the early 1900's. In the summer of 1950, the first recorded rat colony in Alberta was discovered on farm near Alsask on the Saskatchewan border.

In 1954, the Alberta Department of Agriculture initiated a municipal-provincial rat control program that is

still in use today. Rat control legislation was passed and pest control officers were appointed in every city, village, town and rural municipality in the province.

The Norway rat is not a native of Norway, and travelled on other than Norwegian ships, but the name stuck.

Largely due to the foresight of an agri-orientated government and a high degree of co-operation from the public, this program succeeded in preventing the colonization of Alberta by rats. To the present day, this province remains one of the few areas in the world which can legitimately claim a "rat-free" environment.

Rat control efforts were not started in Saskatchewan and Manitoba until the 1970's, by which time the Norway rat had become established in all parts of these provinces where man had settled. Total eradication of the rat from Saskatchewan or Manitoba has not yet been attempted. However, a rat control assistance program was begun in 1978 by the Saskatchewan Government.

ECONOMIC LOSSES

Wild rats are recognized as the most destructive vertebrate animal in the world, both in terms of economic losses they cause, and in their effects on human health.
Losses caused by rats can be divided into 3 categories:

- Losses to foodstuffs
- Physical damage caused by gnawing and tunnelling
- Disease transmission

Losses to Foodstuffs

Rats consume or contaminate approximately 1/5 of all the world's field crops planted each year, including at least 4% of all stored grains.

Rat damage occurs during all phases of food production and storage. Rats eat about 10 percent of their weight each day, some 20-40 kg (10-20 pounds) per year; but they usually contaminate 5-10 times the food they eat with urine and feces. In a year's time, a single rat will produce about 25,000 droppings.

It has been estimated in years past that one-quarter of all farm fires of "unknown origin" in the United States were probably started by rodent damage to electrical wiring.

Physical Damage Caused by Gnawing and Tunnelling

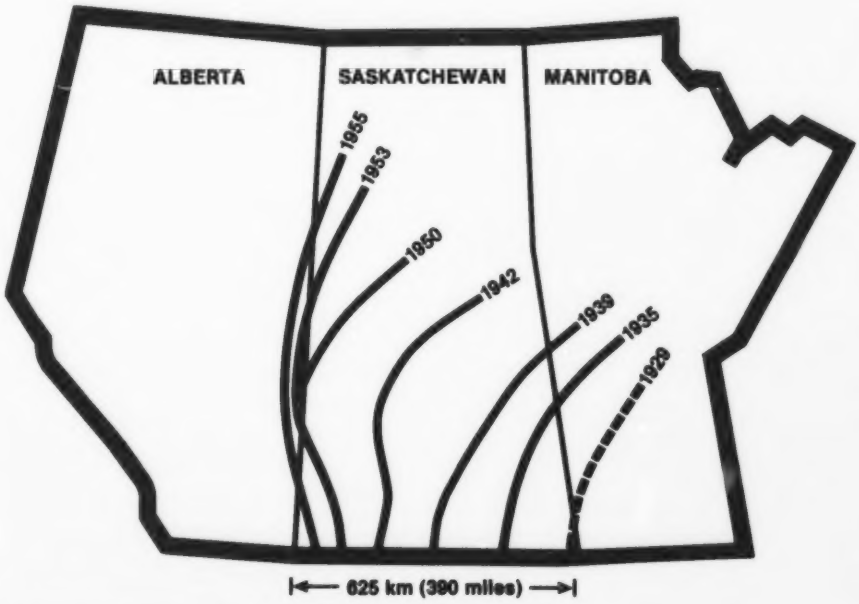
Rats damage structures and materials by their gnawing and burrowing activities.

Common types of damage include:

- extensive gnawing damage to buildings and structures caused by the construction of elabcrate food-access routes, nest sites and escape routes.
- particularily destructive to granaries and other structures containing food and feed.
- undermine foundations and walls causing foundations to sag, and allowing cold air entry which increases frost heaving.
- destruction of wall and ceiling insulation causing increased fuel consumption, increased condensation on walls and ceilings shortening the life of materials, and increased "cold stress" of livestock.
- gnaw through lead pipes, plastic hoses, conduits of all types and electric wires.

Disease Transmission

In addition to the direct dollar losses caused by rats, there is also the intangible cost of rat-associated disease and injury. Rats, by the nature of the environment they live in are regarded as highly



The westward movement of the Norway rat across the prairies.

likely sources of disease. They often feed on garbage and other waste products. They frequently live in sewers and other areas of high contamination.

Hundreds of **rat bites** are believed to occur in Canada, although most cases are never reported. Only occassionally do rat bites cause serious illness but all rodent bites should be promptly and carefully cleaned and disinfected. Tetanus immunization or booster shots are recommended. **Rabies** is not considered a threat as rats have never been found naturally infected with the causative virus.

Rats are responsible for the spread of a number of diseases, either directly as by contamination of food and feeds with their urine, feces, and other body secretions, or indirectly by way of rat fleas or mites.

The following are some of the more common rat-transmitted diseases which might be present on the prairies:

- **Rat bite fever** is caused by 2 bacterial strains found on the teeth and gums of rats. They cause swelling of lymph glands, muscular pain and delayed relapses long after apparent recovery. Infection may occur in persons working or living in rat-infested buildings. Actual contact with rats is not necessary.
- **Leptospirosis**, a serious disease of man and cattle with a mortality rate approaching 20% with some strains of this organism, is believed to be occurring more frequently in recent years. The disease was found in wild rats from British Columbia in 1982 (9). In cattle, abortions are common. The disease agent, is transmitted in rat urine through wet, rat-infested surfaces or drinking water.

Child's lunchbox gnawed by a Norway rat.

- **Epidemic jaundice** or **Hepatitis** is a mild to seriously disabling group of related diseases, most common amongst school children and young adults. This virus is commonly spread via infected human or animal feces to contaminated water and foods such as milk, meats, raw vegetables and bakery products.
- **Salmonellosis** and other related bacteria cause a severe food poisoning which can be fatal in young or infirm persons. This very common and world-wide infection occurs from contamination of man's food and eating utensils by infected rat droppings.
- **Tularemia**, a fairly common disease of rodents is easily transmitted to man either by direct contact with affected rats (especially if the rat is bleeding) or by the bite of a tiny mite carried by rats. Death occurs in about 5% of untreated cases.

The World Health Organization estimated that rats destroy enough food to feed 200 million people every year.

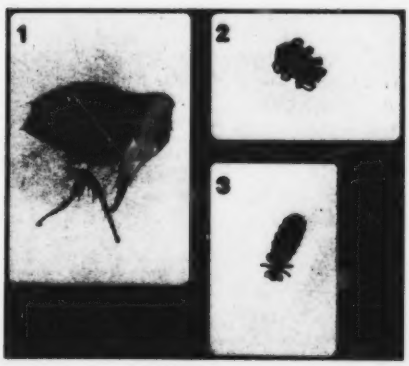
- **Murine typhus** is a rickettsial (bacterial) disease of rats which is transmitted to man and domestic animals, by several species of rat fleas. The disease is fatal in roughly 2% of the population, with older and infirm individuals usually more susceptible.
- **Trichinosis** is a parasitic infection of muscle tissues by a small roundworm which affects both man and livestock. Rats have been shown to transmit this dangerous infection in their droppings. Pork has traditionally been the major source of infection to man, especially when waste food products, infested with rat droppings, are fed to hogs. Heavy infections are often fatal.
- **Toxoplasmosis** is a disease of rats which can be transmitted to humans and livestock by the domestic cat. Cats are infected by eating infected rats. The infectious organism is passed to humans, through either consumption of undercooked infected meat or through ingestion of food or soil infested with with cat feces. The most serious hazard of Toxoplasmosis is to pregnant women, causing malformation, retardation and death to the fetus. Rats infected with this parasite were found in a Guelph, Ontario study in 1977 (22).
- **Other internal parasites** commonly carried by rats include many other species of worms and organisms which cause symptoms from mild diarrhea, to death. Poor weight gain, increased abortion and increased susceptibility to other diseases are often caused by these parasites. The method of contraction varies (ex. spotted fever, Amebiasis, Giardiasis).

In addition to their capacity for disease transmission, many species of mites, fleas and lice which commonly live on rats will also bite humans causing painful swellings and other skin disorders.

The volume of literature on the importance of rats in diseases of man is enormous. The few diseases discussed here are only reminders that our society is not so affluent, nor our medical achievements so advanced that we can be complacent about the damage that rats can still do to human health.

Preventative measures for rat-transmitted diseases must include:

- rat eradication program using all preventative measures and control materials
- rat-proof all food and feed holding structures
- proper maintenance of waste disposal sites
- good sanitation and housekeeping
- proper disposal of human and animal wastes
- report rat infestations to local PCO's or Public Health Inspectors.



1. Northern rat flea ***(Nosopsyllus fasciatus)***,
2. Spiny rat mite ***(Echinolaelaps echidninus)***
3. Spiny rat louse ***(Polyplax spinulosa)***.

BIOLOGY AND BEHAVIOUR

The Norway rat is a very prolific and adaptable animal. It thrives in a wide variety of habitats. It adapts well to most man-made environments and, in fact, is intimately associated with many of man's activities and enterprises.

Proper identification of pests is essential in any pest management program. Knowledge of the biology, physical abilities and behaviour of the pest can greatly aid the decision making process. Proper identification is essential for good control.

To control rats one must understand the rats' habitat requirements, reproduction capabilities, food habits, life history and behaviour.

LIFE HISTORY

Born in a nest about 21 to 23 days after conception, young rats are naked and their eyes are closed. Females may mate again within a day or so of littering. When this occurs, the gestation (time from conception to birth) period may be a few days longer than otherwise. The young develop rapidly, growing hair within a week. When they are 9 to 14 days old, their eyes open, and they begin to explore for food and move about near their nest. In the third week they begin to take solid food.

Litter of Norway rats at 3 weeks.

The size and number of litters depend on, and vary with habitat restrictions, availability of nutritious food, density of the local rat population and age of the rat. In general, Norway rats have large litters (8 to 12 young). Under ideal conditions Norway rats can produce up to 6 or 7 litters in a single year.

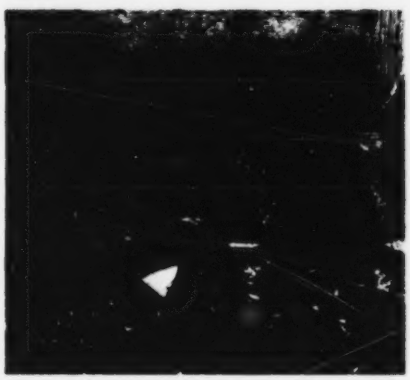
The young may continue to nurse until 4 or 5 weeks old. By this time they have learned a good deal about what is good to eat by experimenting with potential food items and by imitating their mother.

Young rats cannot generally be trapped until about 1 month old. At this time, Norway rats weigh about 35 grams (1.5 ounces). At about 3 months of age they are completely independent of the mother and are reproductively mature. The females come into heat (estrus) every 4 or 5 days and remain receptive to males for a day or two.

The life-span of a Norway rat may extend from 9-14 months in the wild.

IDENTIFICATION

The adult Norway rat weights an average of 450 g (1 lb). Body length various from 190-255 mm (7.6-10 inches). The tail is round, almost hairless and shorter than the body, averaging approximately 180 mm (7 inches) in length. Their snout is blunt, ears thick and short with fine hairs.

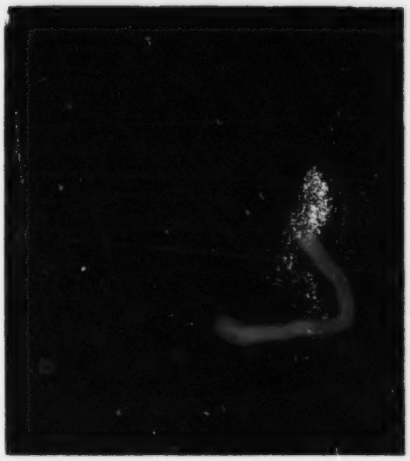


Adult Norway rat gnawing on wooden stud.

The Norway rat has a wide range of fur colours on the back and sides, ranging from grizzled reddish to grayish brown, or completely black. The under-parts are tinged gray to yellowish-white. Even white and white-spotted individuals occasionally appear in the wild. Many such populations are believed to be the result of released albino rats or laboratory specimens. All varieties of white and other-colored laboratory rats stem from the wild Norway rat and will readily cross with wild Norway rats.

NESTING REQUIREMENTS

The Norway rat lives at or near ground level. It nests and burrows in the ground, under buildings, particularly barns, poultry or livestock facilities, and under other structures such as granaries, bale stacks and feed storage containers. Their burrows are often found at the base of rubbish piles, in garbage dumps, sewers or septic tanks, and under lumber piles and litter of various types.



Double wall construction in buildings offers an ideal site for a Norway rat nest. Note straw and debris between the studs.

Nests are usually shallow (less than .3 meters, or 1 foot deep), horizontal, and simply constructed with 1 or more exits, or "bolt" holes. They are usually about 1 meter (3 feet) in length, but may be quite complex and extensive in areas where burrowing is easy, or in piles of junk where natural spaces already exist. In these places, burrows often reach a depth of 1 meter.

SENSES

Sight: Rats see poorly, relying more on smell, taste, touch and hearing. They are considered to be colour blind, responding only to the degree of lightness and darkness of colours. Thus, for safety reasons, baits can be made various colours without affecting their acceptability to rats.

Smell: They use their keen sense of smell to locate food items and apparently to recognize other rats, especially those of the opposite sex. More research is needed to determine the value of various odours either as attractants or repellents. Rats do not usually shy away from the smell of humans on food items, traps or baits.

Taste: Taste perception of Norway rats is good, and they can easily detect certain compounds at extremely low levels (0.5 ppm) in their diets. Once they have tasted a food item, taste probably overshadows or overrides any effect of the odour of that material.

Hearing: Rats recognize noises and use their acute hearing to detect and escape danger, but more research is needed on how much their activity is affected by

sounds. Many of the sound-producing devices advertised for frightening rats from buildings lack sufficient supportive research data.

Touch: An important sensory factor with rats is touch. The long, sensitive whiskers (vibrissae) near their nose and the guard hairs on their body are used as tactile sensors.

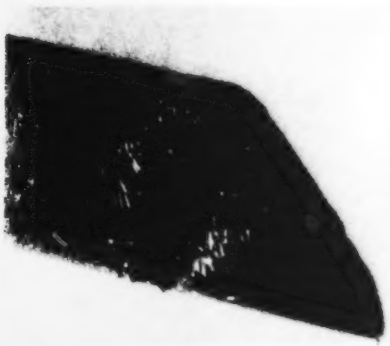
The whiskers and guard hairs enable the animals to travel in the dark adjacent to walls and in burrows.

Balance: Rats also have an excellent sense of balance. Like a cat, a falling rodent always lands on its feet. A Norway rat can drop as much as 15 meters (50 feet) without being killed or seriously injured.

PHYSICAL ABILITIES

Burrowing and Gnawing:

- Burrow vertically 1 1/4 meters (4 feet).
- Gnaw through a wide variety of materials including lead pipe, brick, cinder block, aluminum sheeting, plastics and glass.
- Gain entrance through any opening that is larger than 1 1/4 cm (1/2inches) square.



Lead pipe gnawed by a rat.

Climbing: The Norway rat can climb quite well when necessary. When rat proofing a structure, it would be wise to consider that the Norway rat can:

- Climb both horizontal and vertical wires.
- Climb the inside of vertical pipes that are 4 to 10 cm (1.5 to 4 inches) in diameter.
- Climb the outside of vertical pipes of any size, if the pipe is within 7 .5 cm (3 inches) in diameter.
- Crawl horizontally on any type of pipe or conduit, and even along power lines.
- Climb brick or other rough exterior walls which offer footholds, to gain access to upper stories of structures.

Jumping and Reaching: Norway rats can also:

- Jump vertically as much as 1 meter (36 inches) from a flat surface.
- Jump horizontally 1.2 meters (48 inches) on a flat surface.
- Reach as much as 33 cm (13 inches) along smooth vertical walls.

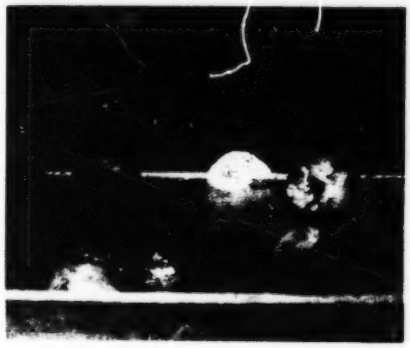
Swimming: Norway rats are good swimmers. They are able to swim up through floor drains and toilet bowl traps. They may swim as far as 0.8 km (1/2 mi), dive through water plumbing traps, and travel in sewer lines, even against substantial water currents.

BEHAVIOUR

Feeding Habits: Rats are omnivorous, meaning they eat nearly any type of food, although each colony or group of rats has its own preferences. The Norway rat is an avid consumer of man's garbage. They feed to varying degrees on cereals, nuts, fruits, vegetables, insects, fish, and even manure, depending on habitat conditions.

Rats are a nocturnal animal which means they are active by night. They usually begin searching for food shortly after sunset. When hungry, or under crowded conditions, they may also be seen in daylight. If the food is in an exposed area and too large to be eaten quickly, yet not too large to be moved, they will usually carry or drag it to a hiding place before eating it. Many rats will cache or hoard considerable amounts of food.

The water requirement varies with diet, but most rats drink water regularly if it is available. In the winter months rats will eat ice or snow. Where no water is available, rats are believed to obtain moisture from green vegetation and dew.



There is no single type of food which is preferred over all else by rats. The most acceptable bait is often local food that rats have already become accustomed to.

Social Behaviour: Rats can be very aggressive with members of their own kind, especially when they become numerous. Dominant males exclude other males from the burrow, which may be occupied by several females. This is one major cause of rat migration.

Rats tend to separate themselves socially into distinct heirachies or social orders. These orders are determined largely by fighting. The more dominant individuals occupy the better habitats and feed whenever they like, whereas the less fortunate individuals may have to occupy less suitable habitat and feed when the dominant rats are not present. Again, migration will occur when all suitable habitat is occupied. This accounts in part for rats being seen in daylight when rat populations are very dense.

Female rats sometimes mate within a few hours after giving birth. Inbreeding is common.

Reaction to Strange Objects: Rats will often avoid strange objects, sounds and other changes in their environment for 3 or more days. The rat will recognize a trap or poison bait only as a new object to be avoided; something which may be hazardous. Unfamiliar sounds, or even a change in location of a familiar object may cause avoidance, or a noticeable drop in feeding. In environments where strange objects appear regularily, such as at dumps or in busy warehouses, rats may show little evidence of shyness.

FACTORS AFFECTING RAT POPULATIONS

The rates of reproduction, mortality, and movement control the size of a population at any given time. The question remains, however, as to what controls the relative importance of each of these three factors. What decides whether the reproduction will be high or low; or if more rodents will die than are being born? The factors controlling this balance are the factors which really determine the size and rate of change in a population. These are called the limiting factors.

Limiting Factors

The most important factor determining rat population densities is the suitability of the habitat. This is made up of three elements:

- **food & water** - Improperly handled feed and food, garbage and field crops are the major sources of rodent food.
- **harbourage** - Sufficient protective cover from enemies and the weather.
- **climate** - Weather conditions directly affect the number of rats that survive the prairie winter. Climate will have little effect on those rats which live in buildings or other structures provided by man.

Predators, parasites and disease will also act to reduce rat numbers, however, their effects are usually sporatic and temporary. As competition between rats increases, strife between individuals and social orders causes increased migration and mortality, as well as lowering the reproduction rate.

Movements

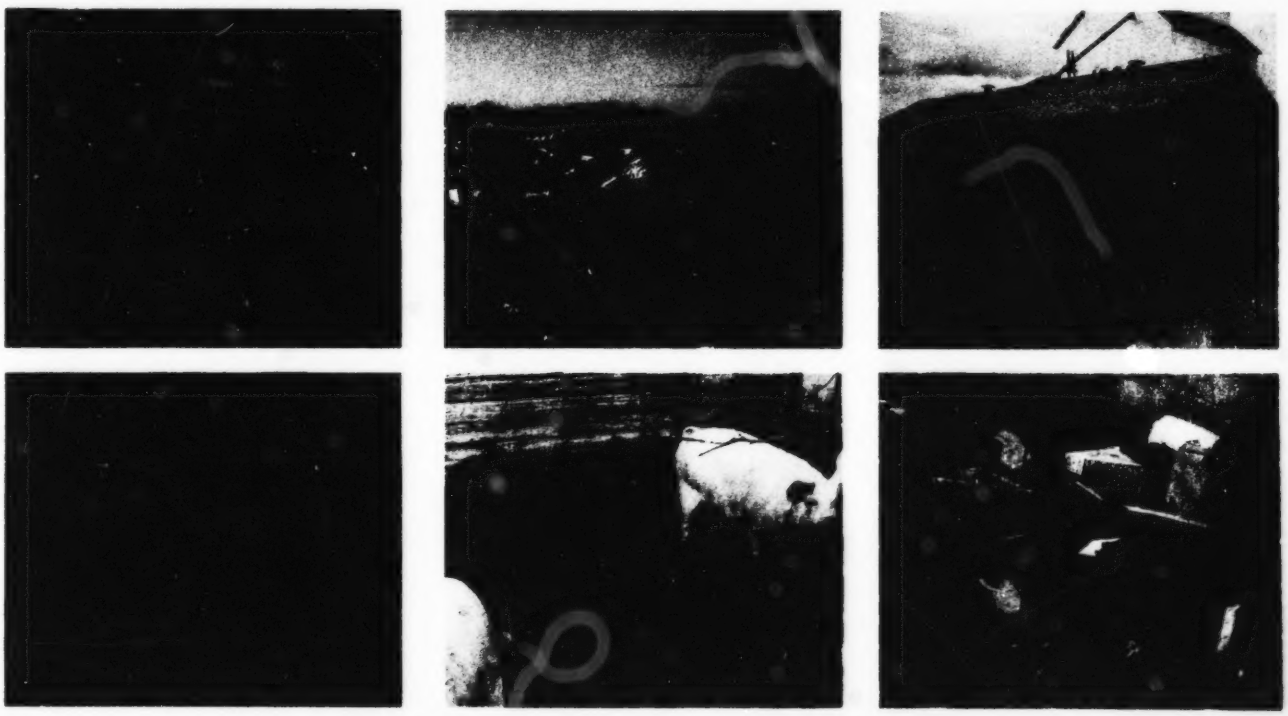
The limited area in which all animals live is called their **home range.** The size of this home range, depends on the nearness of food and water from a harbourage site. The Norway rat seldom ranges more than **100-150 feet** in any direction from its burrow in search of food and water.

If the supply of food and water is removed, or is no longer enough to feed the existing rats in a colony, then migration occurs. The younger and less dominant rats must leave the colony in search of another harbourage site which has a surplus of food and water. It is during this migration, when rats are moving about in unfamiliar territory searching for a suitable habitat, that mortality is the highest.

Removal of Habitat

The great adaptability of rats to man-made environments and the high fertility rate of rats make for quick increases of their populations. A control operation, therefore, must reduce numbers to a very low level, otherwise, rats will not only reproduce rapidly, but often temporarily soon exceed their former density.

The most lasting control can be achieved by permanent alterations of the physical environment of rats. Man should change the environment to promote increased competition and predation, thereby lowering the ability of the environment to support rats. **Unless the suitability of the rat's habitat is destroyed by improved sanitation and ratproofing, control methods must be unrelenting if they are to be effective.**



Typical rat harbourages and major problem-areas for rats on the prairies.

RECOGNIZING A RAT INFESTATION

Rats are nocturnal and secretive so that their activities are largely confined to the night time. Consequently, they often go unnoticed until large populations have developed. It is important to learn to recognize the early signs of a rat infestation so the rats can be eradicated before they getting out of hand. The following is a description of some of the major signs that will help you recognize a rat infestation.

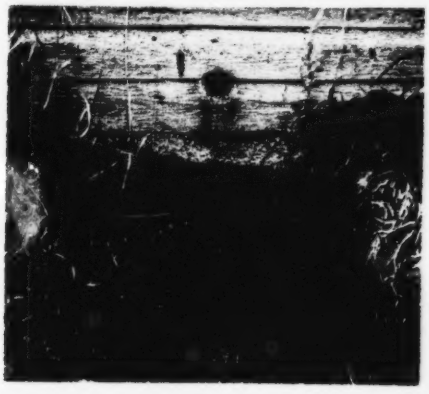
Burrows

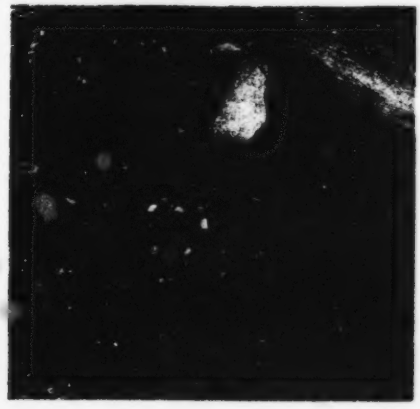
An early sign that a rat has become established is a new burrow. While rats will nest in double walls and floors, they prefer to live in shallow burrows under foundations, floors, scrap piles or feed stacks. Note that a rat burrow does not have loose dirt around the exit as ground squirrel burrows do. The entrance to a rat burrow is about 4 - 8 cm (1 .5 -3 inches) in diameter. Burrows in use are free of dust and cobwebs. All old burrows should be closed after eradication of a rat population. Don't give a migrant rat a free home.

Rats prefer to construct their burrows at the base of a vertical surface such as the side of a building, a pile of debris or in a ditchbank. They sense the security of a firm roof over their heads. Burrows are invariably located within 100 feet of the rat's food and water source, and frequently closer.

Rat Runs

Since rats use primarily the sense of touch rather than sight to find their way, and since a rat population has a definitely marked territory, a well established population will leave well beaten trails from their nests to food and water sources.





Typical rat burrows.

Rats runs (above) should not be confused with field mouse runs which are much narrower.

Droppings and Urine Stains

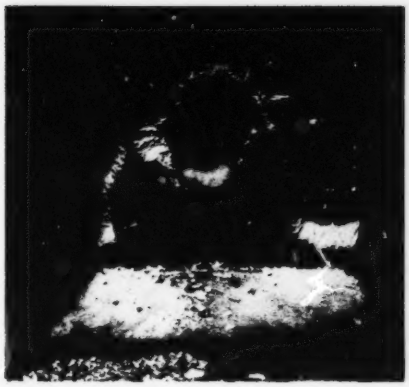
Rat "scats" or droppings are capsule shaped (blunt ends) and approximately 20 mm (3/4 inch) in length and 6 mm (1/4 inch.) in diameter. They are easily distinguished from mouse droppings which are much smaller and have pointed ends. Look along walls in dark or protected areas, or around food and water sources. Fresh droppings are black, shiny and soft. After a few days they become moldy or dull black and hard. Old droppings are dull gray.

A single rat produces 25,000 droppings a year; that is roughly 40 - 125/day. If both small and large droppings are present in abundance it indicates that the population is actively breeding. Rat urine fluoresces under ultraviolet light.

Rats contaminate 5-10 times the food they eat with their droppings and urine.

Gnawing

A rat's teeth grow at the phenomenal rate of 12 - 15 cm (4 3/4 - 6 inches) per year. They must gnaw constantly to wear them down. Look for fresh signs of gnawing around doors, windows, cracks, knot holes, exposed edges of boards and concrete. Fresh gnawings on wood are light coloured showing distinct teeth marks 2 - 4 mm (1/16 - 1/8 inches) wide and fresh wood chips.



Rat damage to chalkboard.

Tracks

The presence of fresh tracks on dusty surfaces such as grain dust, on wet soil after a rain or in fresh snow is a sure sign of an established population. Rat tracks are quite distinct from other rodents. The front imprint is 4-toed while the back imprint is 5-toed ("thumb" of the front foot is higher up the leg). The hind foot print is about 2 - 2.4 cm (3/4 - 1 inch.) long, but may be shorter when the rat is running. Flour or talc may be spread along walls to detect an infestation or check for complete eradication.

Rat tracks in mud. Tail marks may also be visible in dusty locations.

Sounds

Rats may be heard at any time of day, but most commonly just after dusk. Noises of gnawing, scurrying about, fighting and squealing are common.

Odours

A well established rat population has a characteristic odour. Rats have a musty odour in comparison with the pungent odour of mice.

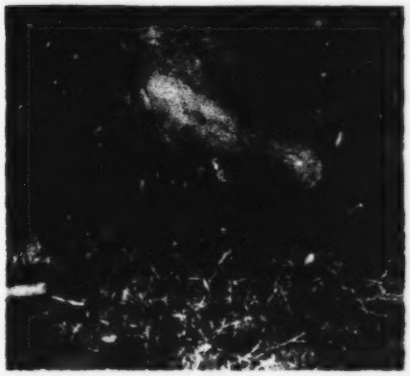
Visual Sightings

When rats become over-populated they relax their secretive habits and maternal care because of acute competition for food and living space. Rats normally begin their activities at dusk, but when they are over-populated they continue to feeding throughout the night. The weak individuals may feed during the daytime. Therefore, if rats are active during the day time,it may indicate a large population is present, in proportion to the available habitat.

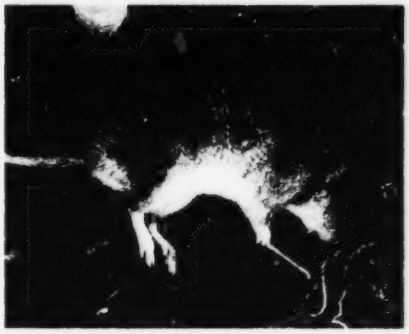
Rats are not usually seen during daylight hours unless the population is under stress because of food shortage.

Pet Excitement

One of the first signs that a migrant rat has appeared on a premise is often that of a dog barking or probing a wall, floor, scrap lumber pile or bale stack. Investigate promptly, even though there is a good possibility that it is a false alarm. Once a rat population becomes established, dogs often become indifferent.



Although your dog might become excited when rats are present, dogs are generally not very effective "ratters".



In some Asian countries, wild rats provide the human population with a convenient source of dietary protein.

Rat Carcasses

Rats in crowded populations succumb to death from a number of natural causes, such as predation, diseases and fighting with rats from an outside colony or while establishing social rank.

Smudge Marks

Rats have very oily skin. After using the same runs for a considerable time, oily smudge marks build up along walls and uprights where they are constantly in touch with them. Smudge marks are often seen under roofing beams where they abutt against main joists.

An experienced Pest Control Officer will not likely miss these tell-tail signs of a well-established rat population.

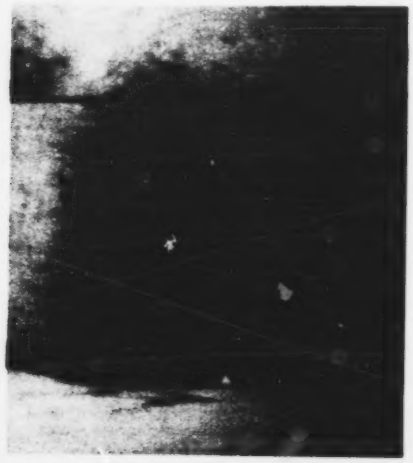
Nests and Food Caches

Rats generally conceal their nests very well and usually in relatively secure and protected places. Favorite spots include between double wall's, under floors and granaries, haystacks, etc. In over-populated conditions, rats will nest in unusually exposed areas. Look for them under junk piles, stone or wood piles or waste straw. Occasionally they are on upper floors of buildings. Large food caches may also be common. Watch for quantities of pet food, bones, and other dry food materials stored away in secluded locations.

SIMILAR SPECIES

People often mistake other species of animals for Norway rats. Here are some distinguishing characteristics to look for when attempting an identification.

The **roof rat** (*Rattus rattus*) also known as the black rat, is sometimes introduced onto the prairies with freight shipments. Slightly smaller and less robust than the Norway rat, it is darker in color and its tail is longer than its body. The roof rat is more agile than the Norway rat and it usually lives in attics and the upper levels of buildings. It is common in seaports and coastal areas. Its destructive potential rivals that of the Norway rat. Trapping this species is often preferred to baiting as it can be difficult to find the individuals in the building after they have died from poisoning.



The **wood rat or pack rat** (*Neotoma cinerea*) a native of western and southern Alberta does not cause agricultural damage. They have large ears, longer fur and a bushy tail. It builds stick nests, often in caves, abandoned buildings, or on rocky ledges. Wood rats do not form colonies but they may cause some damage to interiors of buildings.

Tree squirrels, close relatives of the ground squirrel, are similar in appearance except that their tails are longer and much more bushy. They are never found far from forested or sparsely-wooded areas. As their name implies, they usually nest in trees but on occasion will enter attics where they construct nests of leaves and other vegetation.

Tree squirrels will sometimes cause minor gnawing damage to obtain food or access a nest site, and they will also dig short burrows where they cache winter food stores. The most common squirrel of the prairies is the Red squirrel (*Tamiasciurus hudsonicus*). The Northern flying squirrel, which is active at night, and the Eastern grey squirrel are common is some areas as well.

Ground squirrel (*Citellus spp.*), commonly misnamed "gophers", can be a serious pest to farmers because of their habit of invading grain fields and gardens where they feed on and destroy seeds, seedlings, forage and grain. All 4 species found on the prairies can be easily distinguished from rats by their short, bushy tails and large eyes. Ground squirrel burrows are distinct from rat burrows because they are always accompanied by a mound of earth made from the soil removed from the burrow. Active only by day, ground squirrels are usually seen sitting on their haunches "picket-pin" fashion, on the top of this mound of soil. They prefer to build burrows in open spaces with unobstructed views and usually in areas with sparse vegetation such rangelands, and field margins, or cropland where no-till or minimum tillage is practiced.

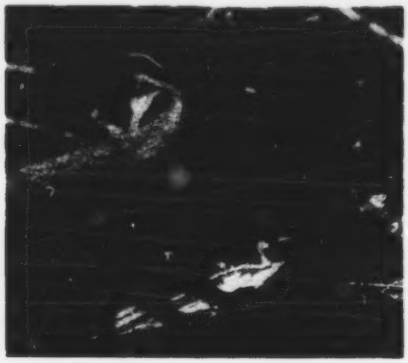
The **Muskrat** (*Ondatra zibethica*) or water rat, is often mistaken for the Norway rat when it wanders away from its watery habitat, as it often does during spring and fall dispersal. Unlike the quick, stealthy movements of the Norway rat, the muskrat's gait is more like a waddle. It is active during the daytime as well as by night. Muskrats grow to about the same length as a Norway rat but their body is much more stout, weighing up to about 1.4 kg (3 lb).

Their dense fur is a rich, dark, shiny brown, overlaid with coarse guard hairs which when wet, give a shiny appearance. The tail is sufficient to distinquish the muskrat from all other mammals. It is hairless, scaley and black, flattenned from side to side, whereas the Norway rat's is round. The muskrat's feet are relatively large, with coarse hairs between the toes which aid in swimming. Tracks differ considerably from those of the Norway rat's. The tail is dragged when moving which leaves a mark in soft ground.

The **pocket gopher** (*Thomomys talpoides*) is seldom seen, as it spends most of the time in underground burrows. It is often misnamed a "mole". The pocket gopher can be easily recognized by its blunt nose, very small eyes, ears almost unrecognizeable, and short tail. They are approximately 22 cm (9 inches) long and weight 150 g (1/3 lb).

Their fur is silky brown, washed with gray and there may be white on the chin, throat or chest regions. They have cheek pouches used for storing food. Pocket gophers are vegetarian however, and do not inhabit buildings.

The **striped skunk** (*Mephitis mephitis*), is easily distinguished from a rat, but their burrows may be similar. Like the rat, skunks will frequently nest under granaries. The skunk burrow however, is somewhat larger and nesting materials such as grass or other debris are often scattered about the entrance. On close examination, the distinctive odour should be noticeable. Skunks do not chew on wood.



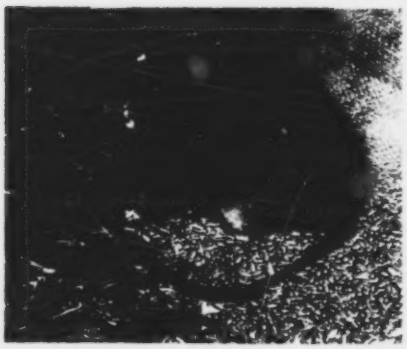
Field mice (top right) and the **house mouse** (*Mus musculus*) occur commonly on the prairies and often become pests. Young rats (right) are often misidentified as mice, a mistake that could seriously hamper control measures. Mice in general have a slighter build than a young Norway rat, a smaller head with pointed snout, and larger ears and eyes. Their tail is equal to, or a little longer than the body. The house mouse will not be any larger than 19 cm (7.5 inches), including tail, and they are usually more grayish than brown.

PREVENTATIVE CONTROL MEASURES

There are four steps which are usually required in any rat control program:

- **Rodent food source removal**
- **Harbourage reduction**
- **Rodent-proofing**
- **Destroying rats**

The first three steps are considered "preventative" control measures, while the fourth step is directly reducing the rat population through "active" control measures, such as poisons, trapping and so on.



Sanitation is the key to controlling rats.

Each step is essential and must be examined carefully. If the conditions necessary to complete one step are not met, the control program will ultimately break down and the investment will be wasted. Poisoning will be necessary at more frequent intervals and complete eradication of rats on a community-wide basis will be impossible.

FOOD SOURCE REMOVAL

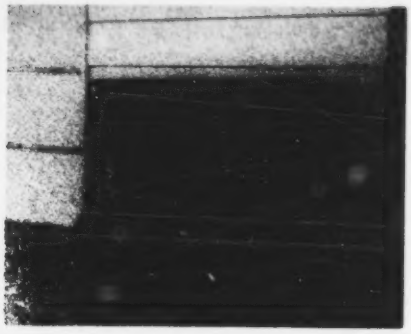
Poor storage of refuse, feeds and food materials in and around the farm is an invitation to rats to help themselves. Rats and mice are effectively controlled by storage of all refuse in rodent-proof containers, the satisfactory collection and disposal of refuse, and by proper storage of usable food and feed materal.

Sanitation: Probably the greatest contributor to rats around prairie farms is the availability of spilled, or poorly stored grains. It is important to clean up all spilled feed and grains, especially in and around buildings and granaries.

Old, wooden granaries placed directly on the ground are frequently damaged by rats and leaking large amounts of grain.

Clean up vegetables and debris from gardens in fall. Make all pet foods (dogs, cats, bird seed, etc.) inaccessible to rats. Rat-proof birdfeeders are very useful.

Garbage Removal: Garbage is a very important contributor to rat infestations, as it provides food, water and shelter. Store garbage in covered containers, with tight fitting lids. Bulk waste containers (dumpsters) may be required for commercial firms, apartment buildings or anyone with large quantities of garbage.



Storage racks built 45 cm (18 inch) off the ground eliminate harbourage, prevent overturning of cans, and can be designed with chains attached to prevent loss of lids.

Garbage should be collected frequently and taken to municipal disposal grounds where **"sanitary"** landfill practices must be maintained. Open refuse dumps are major producers of rats and flies, and both may migrate to adjacent towns and farms.

The following sanitary landfill techniques of refuse disposal can be used so that conditions favourable to rat populations do not develop:

- use the "open-pit" method for placement of wastes.
- separation of waste materials into food, and non-food materials.
- where permitted, burn all "burnable" wastes as often as possible. Local regulations must be observed regarding the burning of materils which produce "noxious fumes".
- unbagged food wastes should be limed, as an alternative to burning.
- animal carcasses should be "prohibited".
- garbage should be compacted and covered with approximately 60 cm (2 ft.) of earth. Large urban centers should do this every day. Smaller towns and operators of rural disposal sites should attempt to compact and bury food wastes as frequently as possible; at least 2 or 3 times each year, and more frequently if burning is not done regularily.

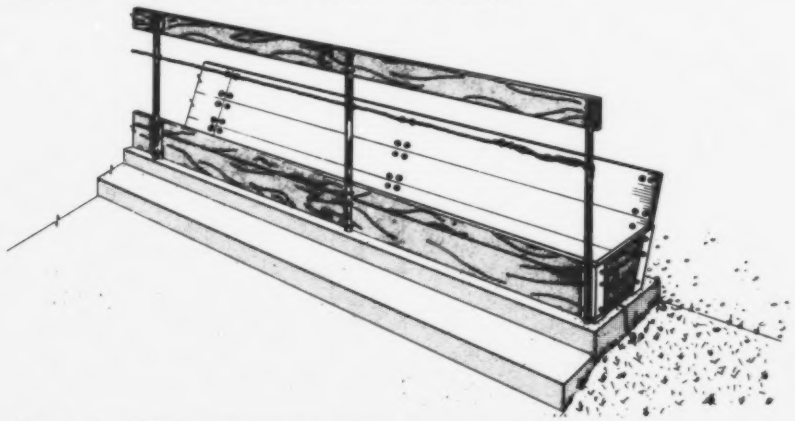
Ensure your waste disposal site is properly maintained and rat free.

- for better long-term management, it may be best to fence the dump site and use a locked gate to regulate access to only those persons authorized to use it. Or the gate could be opened only at specific times, and a Supervisor appointed to ensure regulations are followed.

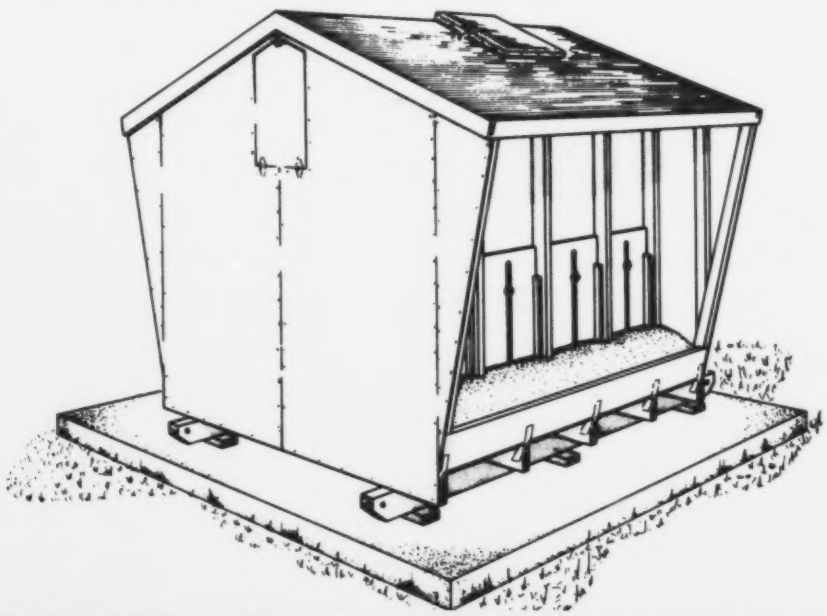
Feed storage:

- Feed bins, granaries and all other food storage areas should be rodent proofed. (see "Rodent Proofing"). Storage containers should be cleaned out within 20 days or less.
- bagged feed storage should be 45 cm (18 inch.) above the floor and 45 cm (18 inch.) away from the walls. Leave 60 cm (24 inch.) aisles between pallets.
- construct feed bunks and water troughs so as not to provide a home for rats. The space between the ground and the feed for self-feeders and feed bunks should be filled with compacted, coarse gravel. The perimeter of feeders and bunks should be sealed off with rodent proof of hardware cloth or metal to keep rodents from entering this space.
- bulk silage storages need regular and routine inspection to prevent establishment of rat colonies.
- all bins and self feeders should be placed on concrete pads.
- do not store forage bales near buildings. Do not use them for insulation.
- check lofts where feed or hay is present.

Sanitation cannot be emphasized too strongly, for it is the basis of long-lasting rat control.



Feed bunks should be built on a concrete base to discourage rodents.



Portable self-feeders cannot be made rodent-proof, but they can be put on a concrete pad and blocked up to discourage nesting underneath.

HARBOURAGE REDUCTION

Another component of preventive rat control which is needed for long-lasting control of rats is harbourage reduction and removal. Rats must have shelter and nesting sites in order to survive and multiply.

Rats move undetected along runways which are sheltered by tall grass, shrubs or rubbish. They nest in well protected, undisturbed places under woodpiles, piles of junk or in old, dilapidated buildings and structures.

- destroy all nesting sites, burrows and hiding places.
- rats shy away from open, exposed areas. Cleanup all debris and miscellaneous materials to expose sheltered areas and reduce the potential for rat harbourages.

Tear down or burn old, unused buildings, particularly old granaries.

- cleanup trash, old car bodies and old machinery.
- store lumber, other building materials and machinery at least 45 cm (18 inches) off the ground and away from walls.
- where possible, park farm implements on blacktop or gravel.
- keep weeds and grass cut, particularly around all buildings and structures where rats might harbour.
- keep trees and shrubs trimmed so they do not provide cover for rats.
- reduce sources of standing water near buildings. Drain or cover water sources which may be used by rats.
- It is important that control measures are continually inspected to be sure they remain effective.

Herbicides can be used to reduce vegetation where mowing is difficult or more costly.

RAT PROOFING

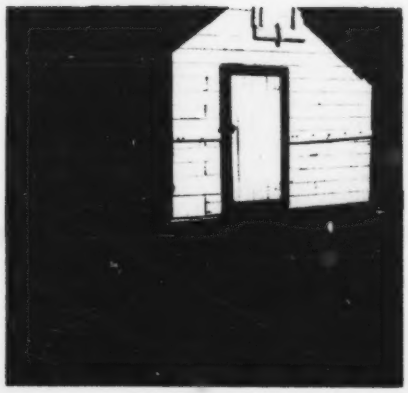
The most successful and permanent form of rat control is to "build them out", that is, make it impossible for rats to gain entrance into any area or structure where they are not wanted. All places where food is stored, processed, prepared, or fed to livestock should be ratproofed. If rats can be denied access to either food, hiding places or water, they obviously cannot survive.

Remember, rats have 4 incisor teeth which grow 10-15 cm (4-6 inches) in a year, and must gnaw each day in order to keep their teeth short enough to use. They can exert a pressure 24,000 pounds per square inch allowing them to chew through many building materials.

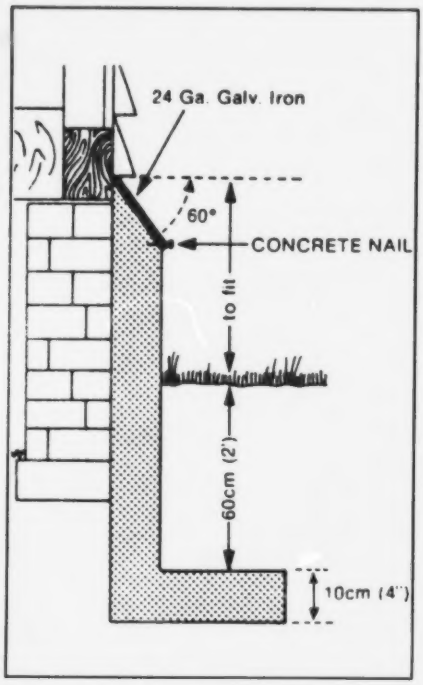
Rodent Proofing Buildings

Outside the building, consider the following:

- **Siding:** Run corrugated steel siding horizontally. Corrugated metal running vertically can leave open ends at the foundation, providing a place for rodents to work their way inside the walls. For existing metal buildings, seal these open ends using metal flashing or mortar.
- **Double Wall Construction:** Eliminate double walls wherever possible as they act as hidden passageways.
- **Doors and Windows:** Doors, windows and screens should be tight fitting. Reduce gaps to less than 3 mm (1/8 inches) to prevent both mice and rats from entering. Fit doors with metal kick plates set close to door edges to prevent rats and mice from gnawing holes in the doors.
- **Drains and Conduits:** Use 12 mm (1/2 inch) screens and 6 mm (1/4 inch) holes in drains; keep them in good repair. Tightly seal all areas where utilities enter buildings.
- **Insulation:** Seal sandwich wall panels all the way around the building to keep rodents out of the insulation. Protect perimeter insulation on the outside of the foundation, with a covering such as asbestos cement board or high density fiberglass-reinforced plastic. This material should extend 95 cm (3 ft.) below the surface of the ground.
- **Foundations:** Construct concrete floors and foundations of high quality materials. Where foundations cannot be completely rodent proofed or where an earth floor exists, build a curtain wall.



Concrete pads are ideal for all granaries. As an alternative, wooden or concrete skids can be used providing bins are lifted 30-45 cm (12-18 inches) above the ground.



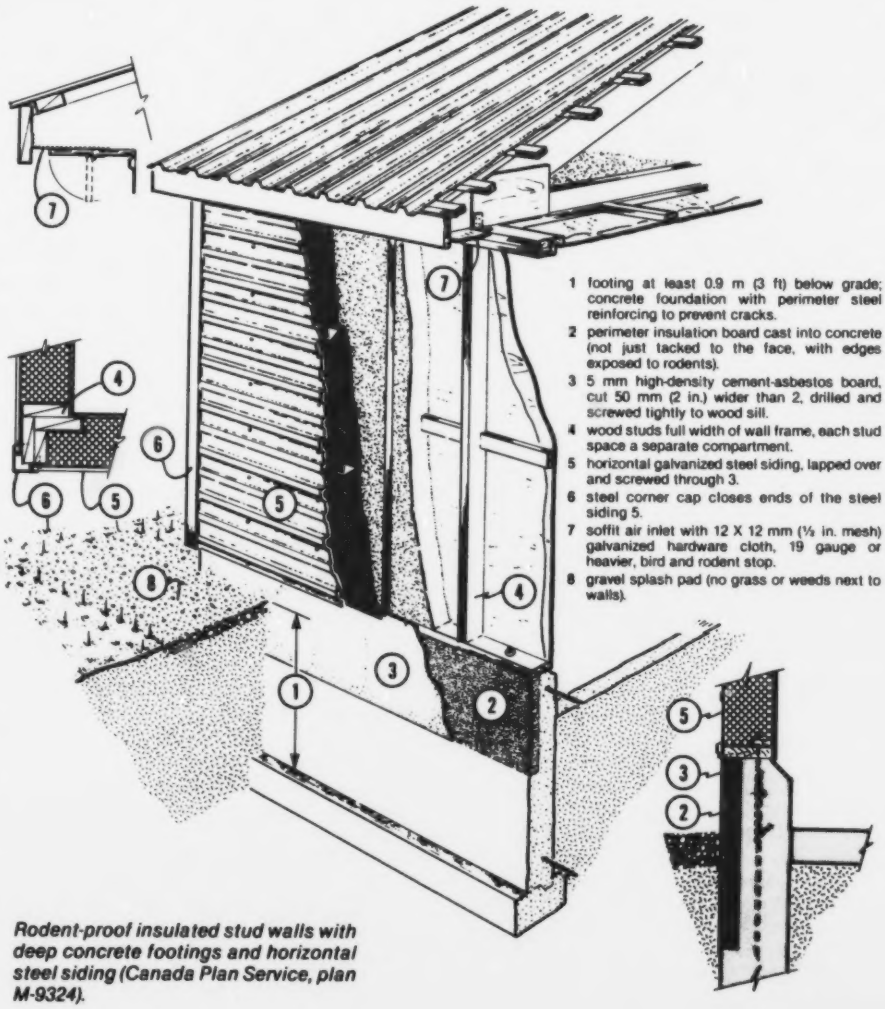
The rat will burrow down to the "L" but not out and around the curtain wall.

TABLE 1 Rodent Proofing Materials

Material	Specification
Sheet Metal	26 gauge or heavier, galvanized or stainless steel.
Expanded Metal	28 gauge or heavier with mesh not larger than 6 mm (1/4 inch) opening, galvanized or rust resistant coating.
Perforated Metal	24 gauge or greater, perforations not to exceed 6 mm (1/4 inch) opening
Kick Plates	20 gauge galvanized metal
Iron Grills	sufficiently heavy to be equivalent to above materials, slots not to exceed 6 mm (1/4 inch)
Hardware Cloth	19 gauge or heavier galvanized or rust proof, not to exceed 6 mm (1/4 inch) opening
Cement Mortar	1:3 mixture or stronger
Concrete	1:2:4 mixture or stronger

Inside the building, consider the following:

- Fill all potential nesting holes inside buildings with rodent proof materials such as concrete, mortar or sheet metal to eliminate all holes 6 mm (1/4 inch) or larger.
- Eliminate hiding places such as under stairways.
- Attach a 46 cm (18 inch) width of sheet metal to all climbable rough walls, 90 cm (36 inches) from the floor.
- Install all wiring on the visible side of the interior lining of the ceiling and walls where rodents are less likely to gain access and where coverings can be easily observed for damage.
- Fill the openings around pipes and conduits with masonry, sheet metal or hardware cloth.
- Cover all drains and manure pump-out ports with tight fitting grills and covers.
- Cover all door edges with sheet metal to prevent rodent gnawing.
- Cover ventilation duct openings with hardware cloth or expanded metal grills with openings no larger than 12 mm (1/2 inch) for rats. These should be set in metal frames. Ensure that ventilation is not restricted. There are a number of materials recommended for repair work (see Table I).



1 footing at least 0.9 m (3 ft) below grade; concrete foundation with perimeter steel reinforcing to prevent cracks.
2 perimeter insulation board cast into concrete (not just tacked to the face, with edges exposed to rodents).
3 5 mm high-density cement-asbestos board, cut 50 mm (2 in.) wider than 2, drilled and screwed tightly to wood sill.
4 wood studs full width of wall frame, each stud space a separate compartment.
5 horizontal galvanized steel siding, lapped over and screwed through 3.
6 steel corner cap closes ends of the steel siding 5.
7 soffit air inlet with 12 X 12 mm (½ in. mesh) galvanized hardware cloth, 19 gauge or heavier, bird and rodent stop.
8 gravel splash pad (no grass or weeds next to walls).

Rodent-proof insulated stud walls with deep concrete footings and horizontal steel siding (Canada Plan Service, plan M-9324).

ACTIVE CONTROL MEASURES

As the Norway rat has such an enormous reproductive capacity, controlling the spread of this species means total eradication, followed by year-round vigilance against new invasions.

In a community-wide rodent control program, poisoning rats is an essential part of the total plan. Timing of the poisoning effort is of utmost importance. Rat poisoning methods are applied most effectively **before** sanitation and clean-up programs are begun to prevent the spread of rats whose burrows are disturbed or destroyed. Then once harbourage and food sources are eliminated, permanent bait stations should be established and monitored throughout the year.

RODENTICIDES

Multiple-Dose (Chronic) Poisons

Over 90% of all rat-control operations in North America incorporate multiple-dose (anticoagulant) baits. Most of these products must be consumed over a number of days to produce death. Anticoagulants act by interfering with blood clotting, with death resulting from internal, and sometimes external bleeding. Rodents die relatively painlessly after eating the treated food over a period of 3 - 10 days.

The familiar 1 pound bag of Warfarin — treated rolled oats is still widely used.

Table 2 lists nine anticoagulant poisons registered for use in Canada. Of these **Warfarin, Fumarin** and **Pindone** have the longest history of use on the farm. These poisons provide a greater degree of safety because they are less potent than some of the new materials now available.

Diphacinone and **Chlorophacinone** are considerably more potent and thus more effective because they require fewer feedings to produce death, and death may occur slightly faster.
NOTE: Diphacinone is very toxic to dogs. Chlorophacinone has moderately low toxicity to birds.

It is a wise practice to periodically change the type of bait used in your control program to avoid the possibility of resistance.

A new group of so called "2nd generation" anticoagulants include **bromadiolone** and **brodifacoum.** They effectively control so-called anticoagulant-resistant rodents. Resistance to anticoagulant rodenticides may become possible if rat populations are fed the same type of poison over a long period of time. Resistance in rats is not a common occurrence and as yet has not been reported at any location in the prairie provinces.

At low bait concentrations, bromadiolone and brodifacoum are capable of producing a high percentage of deaths in rats with only one feeding. These new anticoagulants, have greatly improved rat control efforts around the world.

Because second-generation anticoagulants are more potent toxicants, they have increased potential hazards to nontarget animals and must be used with great care.

Ergocalciferol is a new rodenticide containing Vitamin D2 mixed with warfarin. It causes rapid calcification of the vital organs and blood vessels, a condition called hypercalcemia, death usually occurring from heart attack. It is effective against rats and mice that are resistant to other anticoagulants.

The drug **Sulfaquinoxaline** added to warfarin (PROLIN) will also help control warfarin resistant rodents. It increases the effectiveness of warfarin by destroying bacteria in the rats gut which naturally produce Vitamin K, the antidote for anticoagulant poisoning.

In general, anticoagulants are relatively safe for man and other non-target animals. The onset of symptoms is relatively slow, and when accidental injestion occurs, there is time for administering Vit K_1, an effective antidote, or giving whole blood transfusions. A large, single dose of the older-type anticoagulants such as warfarin, will usually not kill a healthy animal.

Anticoagulants are readily accepted by rats and bait shyness rarely develops to baits of good quality. (Mice can be more difficult to control with anticoagulants).

Failure of anticoagulant baits could be due to one or more of the following (even if bait is readily accepted and eaten):

- Baiting is not done for a long enough time.
- Insufficient bait is put out, or replenishment of bait is too infrequent.
- Too few bait stations are used, or some are not spaced closely enough together. In some situations, stations may have to be within 7 to 10 meters (20 or 30 feet) of one another.
- The control program does not cover a large enough area, permitting rats to move in from untreated adjacent areas.
- Some rats are naturally less susceptible to the anticoagulant. An inherited anticoagulant resistance may have developed to anticoagulants that have been used for many years. This prospect is unlikely but should always be considered, especially if about the same amount of bait is taken daily for a number of weeks. Substitute with bromadiolone or brodifacoum.
- The bait is a poor choice or is formulated improperly.
- The bait station is not placed properly.
- Other foods palatable to the rats are abundant.
- The bait has become moldy, rancid, insect-ridden or contaminated with other material which reduces acceptance. Discard old baits periodically.

Control is always better with fresh baits.

TABLE 2 RODENTICIDES FOR THE CONTROL OF RATS AND MICE IN CANADA

Category	Common Name (* = Recommended)	Trade Name	Active Ingredient %	Formulation S = soluble M = meal P = pellet PB = parafin C = concen. ES = seed	Availability	Mode of Action
ANTICOAGULANT POISONS						
Multiple-Dose Anti-coagulant	*Warfarin		0.025	S,M,P,PB,C	Domestic	Internal bleeding resulting from reduced clotting ability of the blood. Prevents formatic of prothrombin by competition with Vitamin
	Coumafuryl	FUMARIN	0.025	M,P	Domestic	See Warfarin
	*Pindone	PIVAL, TRUEGRIT	0.025	S,M,P,C	Domestic	See Warfarin
	*Chlorophacinone	ROZOL	0.005	S,M,P,PB,C	Domestic	See Warfarin
	*Diphacinone	RAMIK, DIPHACIN	0.005	S,M,P,PB,C	Domestic	See Warfarin
	Warfarin and *Sulfaquinoxaline	PROLIN	0.025 0.025	M,P,C	Domestic	See Warfarin
	Warfarin and Ergocalciferol	SOREXA	0.025 0.1	ES	Domestic	Mobilizes calcium resulting in death from hypercalcemia (organ calcification) and heart attack.
Single Dose Anti-coagulants	*Bromadiolone	BROMONE, MAKI	0.005	S,M,P,PB,C	Domestic	See Warfarin
	*Brodifacoum	TALON, RATAK	0.005	P,PB	LICENCED APPLICATOR	See Warfarin
ACUTE POISONS						
Natural Poisons	Strychnine	MICE ONLY	0.3 - 0.4	M, ES	RESTRICTED	Nervous system paralysis
	Scilliroside	RED SQUILL	10.0	M, paste	Domestic	Heart paralysis
Synthetic Poisons	*Cholecalciferol	VITAMIN D_3 QUINTOX	0.075	M	LICENCED APPLICATOR	Hypercalcemia and heart attack
	*Alphachlorohydrin	EPIBLOC	1.0	M	LICENCED APPLICATOR	Epididymal lesions in males; edema damage to liver and kidneys.
	Zinc Phosphide	ZP	1.0	paste, tracking powder for mice	RESTRICTED	Phosphine gas enters circulatory system, heart paralysis, gastrointestinal and liver damage.
FUMIGANTS						
Fumigants	Gaseous Oxides of Sulfur			Solid	Domestic	asphyxiation
	*Carbon Monoxide			Gaseous	Domestic	asphyxiation
	Chloropicrin			Liquid	RESTRICTED	Extremely irritating to skin, eyes and respiratory tract. Readily absorbed through skin.
	Calcium Cyanide			Dust, Solid	RESTRICTED	Extremely and immediately toxic by inhalation. Readily absorbed by skin.
	Methyl Bromide			Liquid	RESTRICTED	Harmful or fatal if swallowed. Liquid can cause eye and skin burns.

Acute Oral LD_{50}(mg/kg)	Antidote	Absorbed Through Skin	Secondary Poisoning	Degree of Hazard
186	If on skin, wash with soap and water. If in eyes, flush with water 10-15 min. If swallowed, give patient 1 or 2 glasses of water and induce vomiting by inserting finger down the throat. Repeat until clear. Use emetic, if available (1 tbsp. syrup of Ipecac) to induce vomiting. CALL DOCTOR AT ONCE. Blood transfusions combined with intravenous injections or oral doses of Vitamin K, are indicated.		YES	LOW
25	See Warfarin		YES	LOW
15-50	See Warfarin		YES	LOW
20 (.2/day chronic)	See Warfarin	YES	HIGH	LOW — MODERATE
3 (.2/day chronic)	See Warfarin		HIGH	LOW — MODERATE
1000	See Warfarin		YES	LOW
56	See Warfarin, and peritoneal dialysis with a calcium free electrolyte solution containing 4% glucose		NO	LOW
1.0	See Warfarin	YES	HIGH	MODERATE
0.26 (50 dermal)	See Warfarin. Remedial treatment may be required for up to 6 months.	YES	HIGH	MODERATE — HIGH
1 - 30	If swallowed, call doctor immediately. Feed activated charcoal, induce vomiting within 10 minutes of swallowing, otherwise give nothing by mouth. Keep patient absolutely quiet and in dark room. Give artificial respiration if breathing stops.		NO	VERY HIGH
0.43 - 2.15	Natural emetic properties. If vomiting does not occur immediately, induce by giving patient 1 or 2 glasses of water containing 1 tbsp. syrup of Ipecac, or insert finger in throat. Obtain medical attention and keep patient warm.	YES	NO	LOW
?	See Ergocalciferol, and if serum calcium levels remain high, administer Calcitonin.		NO	LOW
150 (lethal) 90 (sterile)	If swallowed, induce vomiting until clear. Call physician immediately. No known antidote.	YES	NO	LOW MODERATE
27 - 40	No specific antidote. Induce vomiting by mechanical stimulation, or syrup of Ipecac, then lavage with sodium bicarbonate, 3 - 5%. If on skin, wash with soap and water. Have patient lie down and keep warm.		NO	HIGH
	Remove victim to fresh air immediately. Keep victim lying down and warm. Give CPR if breathing stops. Call physician.		NO	LOW
	See methyl bromide		NO	LOW — MODERATE
250 ppm (Acute vapour = 0.8 ppm)	See methyl bromide and flush eyes with water for at least 15 minutes if contacted.	YES	NO	VERY HIGH
Acute vapour = 50 ppm	See methyl bromide, and if patient is breathing but unconscious, break a pearl of amylnitrite in cloth and hold over nose for not more than 20 seconds, repeating every 5 minutes for 25 minutes if not recovered. Induce vomiting if swallowed.	YES	NO	VERY HIGH
20 ppm (Acute vapour = 2.0 ppm)	Remove victim to fresh air immediately. Keep victim laying down and warm. Call physician immediately. In case of skin contact, wash with soap and water for at least 15 minutes. Remove contaminated clothing. Give CPR if breathing stops. Induce vomiting if swallowed.	YES	NO	VERY HIGH

Caution: Anticoagulant baits may not be as safe for use as some manufacturers would like you to believe. LD50 values are not very useful in determining the actual toxicity of each product. Many recent case studies have shown that in fact, with some animals (depending on species, age, health, etc.), the amount of rat bait required to kill may be far less than LD50 values indicate. Furthermore, the treatment and recovery period of a poisoned animal is dramatically longer with the more toxic products such as brodifacoum, bromadiolone, chlorophacinone and diphacinone.

Single Dose (Acute) Poisons

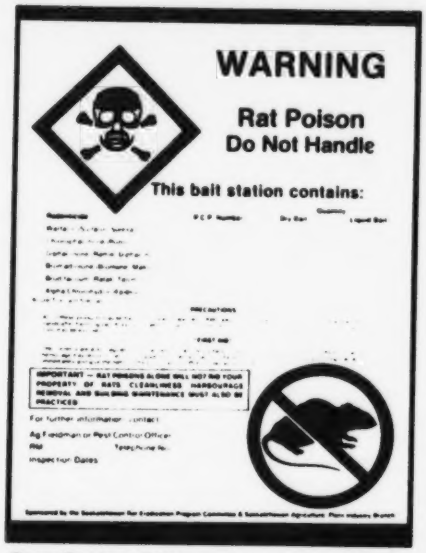
Red squill is the only acute poison which can be handled by the home owner or farmer. It is relatively safe from accidental poisoning because of its bitter taste and because it induces vomiting in man and most animals, excluding rodents. However, red squill is usually only recommended where a very rapid "knockdown" of the rat population is required. It must be supplemented with anticoagulants and should only be used once or twice per year in the same location. Bait shyness might occur when sub-lethal doses are injested.

Zinc phosphide is a black or dark-gray powder, which is usually mixed with grease or oil for use as a rodenticide bait. Phosphorus compounds such as zinc phosphide have an offensive odour and usually an un-attractive colour making it relatively safe against accidental poisoning of humans and domestic animals. The pungent odour and taste appear to be attractive to rodents, particularily rats.

Always be sure to mark bait locations clearly.

Due to its highly toxic nature, zinc phosphide is not recommended for use, except under exceptional circumstances, by a licenced pest control officer.

Epibloc (alphachlorohydrin) is a new toxicant-sterilant bait which may be used where other poisons have failed. As with other acute poisons it should not be used more than twice per year on any rat population. It causes sterility in male rats when consumed in sub-lethal doses. Rats usually die in their burrows several days after feeding. Shyness does not occur.



Pest Control Officers and farmers should record the type and quantity of bait used.

Cholecalciferol or **Vitamin D3** is a new, single-feeding poison, similar in action to ergocalciferol but formulated in baits as the only active ingredient. It has a unique action. Rats will stop feeding shortly after eating a lethal dose. They will therefore not build up excess quantities of toxicant in their bodies, and thus reduce the danger of secondary poisoning. Reduced feeding will also result in better economy of bait used.

Strychnine impregnated seed has some value in controlling mice but it is not well accepted by rats and usually results in bait shyness. Furthermore, strychnine is **not registered for rat control in Canada.** It is extremely dangerous to handle and the likelihood of non-target kills is high.

POISON BAITS

Rodenticides are available as either concentrated poison which must be mixed with a suitable bait (or water), or in a wide variety of pre-mixed poison baits.

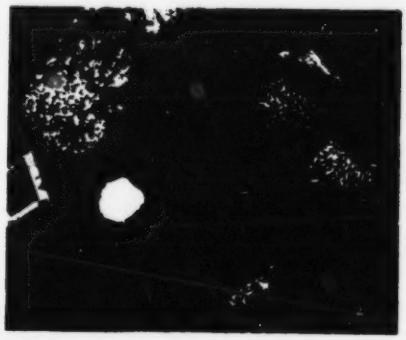
Concentrates: Several rodenticides are available in concentrated form (see Table 1) which are to be mixed with a food material, preferably one which is highly attractive to rats.

Mix baits only as directed. It is a violation to use rodenticides containing more, or less, of the poison than specified on the label. Handle concentrates with extreme care. Avoid inhaling powders or getting poison on the skin.

It is not recommended that farmers or commercial pesticide applicators mix their own poison baits. If PCO's do so, all bait distributed to the public, or placed on public property, must be appropriately packaged and adequately labelled according to regulations.

Pre-mixed Baits: Baits are available in many formulations. Anticoagulant baits are formulated as loose meal, pellets of all sizes and colours, and parafinized blocks which are useful in damp locations.

Bait formulations have changed over the years. For example, pelletized rodent baits are rather common today, although they do not appear to be more effective than the loose meal types. Colours have been added to baits which prevent accidental mixing of the poison with food materials.



Various anticoagulant bait formulations.

It is important to recognize that certain bait formulations may be accepted much more readily in some locations than in others, for no apparent reason. It is good practice to place two or three types of poison at the same location as a means of determining the preferred bait. Baits should be stored in tightly closed containers to prevent contamination by odours or insects, and to preserve freshness.

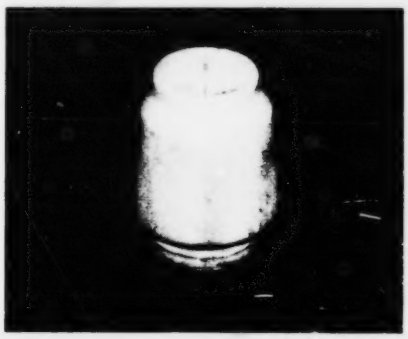
Bait enhancers or additives can be added to baits which may increase their attractiveness to rats. A small amount of sugar, fruit, nuts or meat will sometimes be effective. Used cooking grease added to baits will often attract a rat which is well supplied with other foods. But remember that no amount of sugar, or other attractant will improve a basically unacceptable bait.

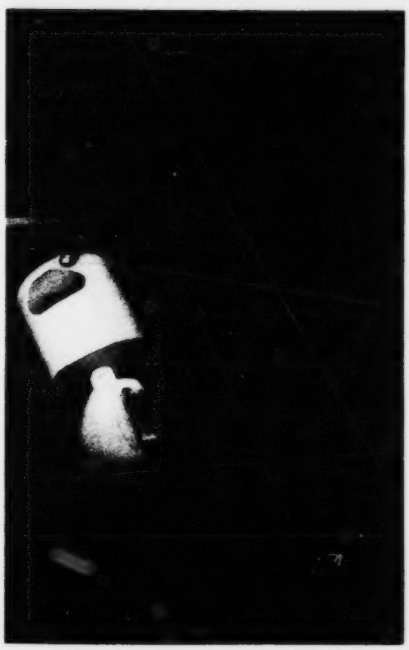
Water Baits

Rats will drink water daily if it is available. Most experts say that rats require at least 30 ml (1 oz.) of water each day in order to survive. Where access to water is restricted or water is naturally limited, water baits can be very effective.

Since water is consumed by almost all animals, it is not selective in its attractability; therefore, water baits should be used only where other animals cannot gain access to them.

Water baits can often be used together with dry baits making a bait station more appealing to rats. Rats will accept water from an unfamiliar source long before accepting dry food.





Water bait dispensers. A simple, inexpensive water bait station can be constructed from 2 plastic jugs. One jug is inserted upside down inside another jug, which has had its top cut off. A 2-inch drinking hole is cut in the side of the bottom jug about 1 inch above its base.

Many types of liquid dispensers are available, but plastic chick-type fountains which hold 1 or 2 quarts of fluid are ideal for anticoagulant water-bait stations (top, left). Water baits can be placed in large bait boxes and maintained as permanent stations if serviced regularly. Even unpoisoned water can be used, so as to attract rats to bait stations if food sources are abundant.

BAIT PLACEMENT

- **Proper placement** of baits can be as important as the type of bait used, or more so. Place all baits in or near rat run ways or near their burrows and harbourages. Do not expect rats to go out of their way to obtain the baits, even though they do occasionally. The best idea is to locate the bait where it will be in the rats' normal line of travel. Baits should usually be placed under cover so the rats will feel secure when they feed. Always remember to place baits out of reach of children, pest, livestock and wildlife.

- **When baiting outdoors** put all baits deep into burrows or in covered rodent bait stations. If placed directly into burrows, baits must be contained in their original packets or bags, **unopened.** This will prevent spoilage caused by moisture and insects. The burrow should then be covered to prevent access by children or non-target animals.

- **When baits are placed indoors** use covered bait stations where possible. It is legal to use open bait trays indoors only when they are protected under equipment, furniture or some other fixed structure which limited access to humans or animals.

- **Routinely inspect baits** to ensure they are not insect infested, moldy or otherwise unattractive to rats. Restock baits as necessary. Remove dead rats immediately, using gloves or a shovel, then bury the carcasses.

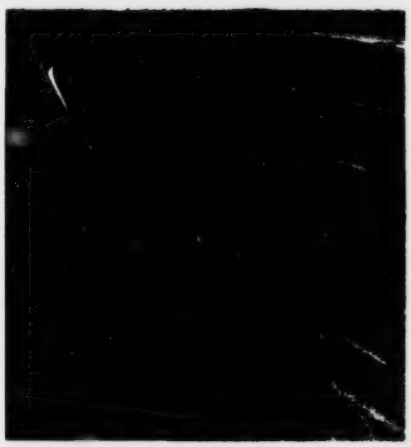
- Place a **sufficient amount of food and water** anticoagulant bait at stations where rodents are accustomed to feeding. Assure an uninterrupted supply of bait for a period of not less than 15 days. Continue baiting until all signs of feeding have stopped.

- **Underbaiting**, particularly with an acute toxicant, leads to bait shyness which will be most difficult to overcome.

- **Prebaiting** is a concept which is restricted almost entirely to the use of acute poisons. Prebaiting is not necessary when using anticoagulant baits because the poisoning action is delayed. The rats will not associate the illness with the bait and therefore continue to feed.

- When poison baits are placed without using a bait box, the bait bag or packet should be attached by means of a string, wire or staple to a fixed object. This technique:

  (i) prevents caching of baits.
  (ii) allows for re-inspection of bait placements to ensure bait is being consumed.
  (iii) permits the individual to remove all uneaten baits.



Always staple or tie down bait bags as rats will often try to carry the bag to their burrow where it might not be eaten.

- **Permanent bait stations** must be placed at key locations to intercept new rats from establishing in a rat-free area. Migrants, especially during spring and fall, will readily fill any vacant nest site and rapidly restore their original numbers.

- Feedstacks of bundles or bales will provide excellent winter shelter and a food source for rats. Unopened bait bags should be placed inside the

stack margin at ground level, every 6-10 metres (20-30 feet). Hay bundles should be constructed with spaces between bundles. In old bale stacks, place baits inside existing gaps in the stack, well out of reach of livestock.

With drifted snow hiding all signs of an infestation around a bale stack, a rat colony might go unnoticed all winter.

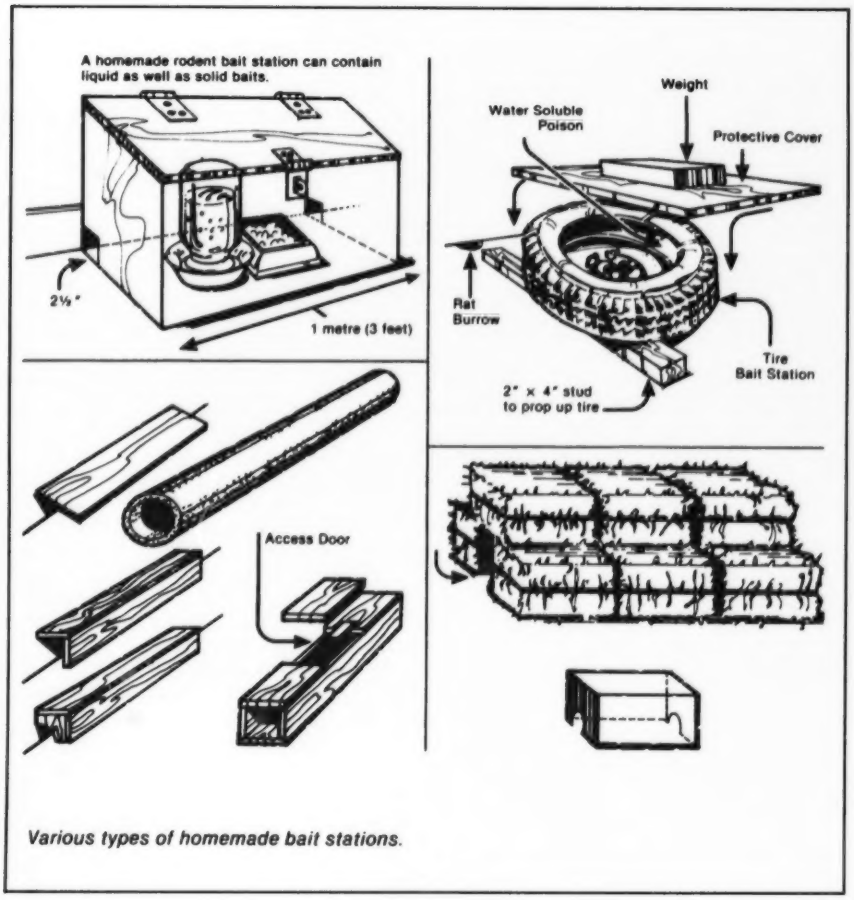
BAIT STATIONS

Bait boxes protect baits from the weather and if built properly, restrict access to rats only. They can provide an excellent safeguard against accidental poisoning of people, pets, and other animals.

Bait boxes, or other types of enclosed bait stations, should be large enough to accommodate several rats at a time. Each station should have at least two openings approximately 6-7 cm (2.5 inches) in diameter. Bait boxes may contain a self-feeder hopper for holding the bait.

Boxes should be placed next to walls or in places where rats will intercept them. Some bait boxes may be large enough that both water and dry baits can be placed inside.

Your Pest Control Officer will help you determine how many boxes are required and where they should be placed.



Various types of homemade bait stations.

Bait boxes are available commercially in a variety of sizes and shapes. They may be constructed of water-resistant cardboard, wood, plastic, or metal. Bait boxes can be constructed to fit the location. They should be made from old lumber or discarded materials as rats will be less likely to shy away from them.

All bait boxes and other permanent bait stations should be clearly labelled "rat poison", and have a poison warning label bearing the skull and crossbones.

Boxes are generally preferred over open bait trays or feeders except in special situations where baits are confined to locked or controlled buildings, hence inaccessible to children and pets. If properly placed, bait boxes provide a secure place for rats to feed on the bait. Since rats are wary, they may not readily accept a new bait station for several days.

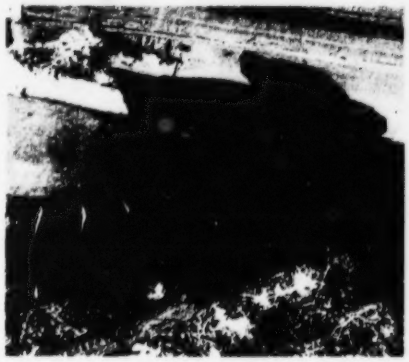
Bait boxes are often maintained as permanent anticoagulant bait stations for controlling rats which may invade an area after the initial population is eliminated.

When first put out, bait boxes should be checked daily. After a while it will be necessary to check the stations only once every other week, or once a month, to replenish or replace old bait with fresh. They must be visited often enough to maintain an ample supply of fresh anticoagulant bait.

With proper transport, one trained worker can service many bait stations each work day, a common practice of professional pest-control operators.

A simple bait station can be made by leaning a wide board against a wall or fence. This will keep children and other animals out, as well as aid in attracting rats to the shelter thus created. Both ends of the bait station should be open, as rats prefer to have several avenues of escape. The ends of the entire bait stations may be enclosed with large-mesh chicken wire to keep poultry and other animals out while allowing rats and mice in.

Use an old tire as a bait station for dry and water soluble baits. Allow access by propping tire on one side, cover tire, and weight it down. Place near existing or suspected rat infestation areas.

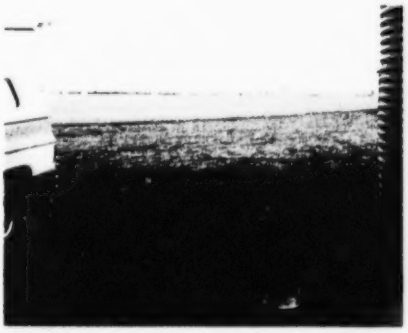


An old disc makes an ideal protective cover for the familiar tire bait station.

FUMIGATION

Fumigation is occasionally used to control rodents in burrows or under floors of out-buildings. Fumigations, are usually confined to structures where other poisoning methods are hazardous, impractical or ineffective. It may be the only control method available in areas where bait acceptance is poor due to other easily accessible food sources.

All fumigants in use are highly toxic to people, animals and plants so extreme caution must be taken to ensure none of these are exposed to the fumigant vapours. Burrows should not be gassed if they are less than 20 feet from an inhabited building. There is the chance that the burrows could lead to openings in the building that would result in fumigant leaking into the structure. If this is the case, remove all people or animals from adjacent buildings.



Gassing rat burrows with exhaust fumes from a gas-powered vehicle.

Fumigation using carbon monoxide fumes from the exhaust of a gasoline engine, is a relatively safe and easy method for use on burrows and under out-buildings. An older model vehicle without emission control equipment is required, or a gas tractor may be used.

For large fumigation jobs, use large hoses such as those used in garages for exhaust. Block exit hole with soil. Use at least a 5 cm (2 inch). hose connected to the exhaust pipe by means of short connecting hoses such as a radiator hose. Run the engine for about 20-30 minutes at fast idle with partial choke. Repeat the process for each burrow. The time required for gassing may vary.

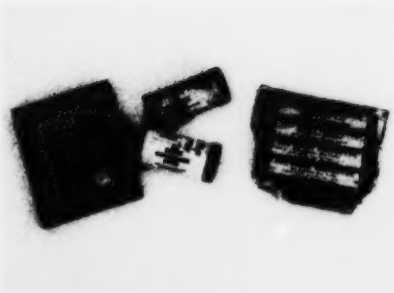
The job can be made more efficient using two vehicles. Place the hose of the first vehicle under the first skid and a hose from the second vehicle under the second skid. After about a ½ hour, move the hoses to the next two skids. Continue until the building is completed.

A gassing job is labour intensive and therefore is usually done only when baiting has failed or immediate control is desirable.

After gassing is completed, the granary should be moved off and the ground dug up to expose any rats which may have survived in the burrows.

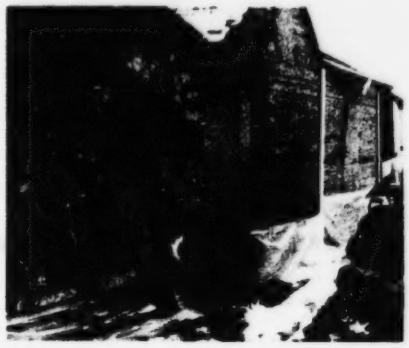
Both empty and full granaries can be treated under the floor in a similar manner. Bank the sides with soil, manure or similar material to prevent the escape of gas or rats.

Sulphur dioxide cartridges are also available for use in rat burrows. They should be lighted and inserted as far as possible into the rat burrow, and the hole plugged with dirt. Any adult may use these without a licence or permit. Because of possible fire hazard, they should not be used under buildings with wooden floors, unless they are placed within a length of stovepipe or similar protective shield.



Various rodent-burrow grassers which are available to the farmer.

Several highly toxic fumigants are available for controlling rats (see Table 2). However, these toxicants are restricted to specially trained, licenced applicators **only**, and are therefore not recommended for use in the prairie provinces.



Plastic sheeting stapled around the granary will provide a good sealant to contain the fumigant.

Doctor _____

Veterinarian _____

Hospital _____

Ambulance _____

Poison Control Centre _____

TRAPPING

Trapping is an effective method of controlling rats, but it requires more skill and labour than does baiting. Trapping is the preferred method in homes, garages, and other small structures where there are very few rats. Trapping has several advantages including:

- no hazardous poisons are used,
- it permits the user to view his success;
- it eliminates rat deaths in inaccessible locations, which frequently create odour problems when poisoning is done within dwellings.

Rats rely on concealment for protection. They avoid open spaces as much as possible. The best places to set traps therefore, are close to walls, behind objects, in dark corners; anywhere a rat striving for concealment might run. Set traps where rat runways, droppings, and gnawings are evident. Traps should be set so that the rat, in following its natural course, will pass directly over the trigger. For example, in setting along a wall, the trap should extend from the wall at right angles, with the trigger end nearly touching the wall.

Bait should be fastened securely to the trigger with light string, thread, or fine wire, so that when attempting to remove it, the rat will be sure to spring the trap. Rats will frequently remove bait which is not secured tightly to the trigger, without setting off the trap. Traps should be set so the trigger is sensitive and will spring easily.

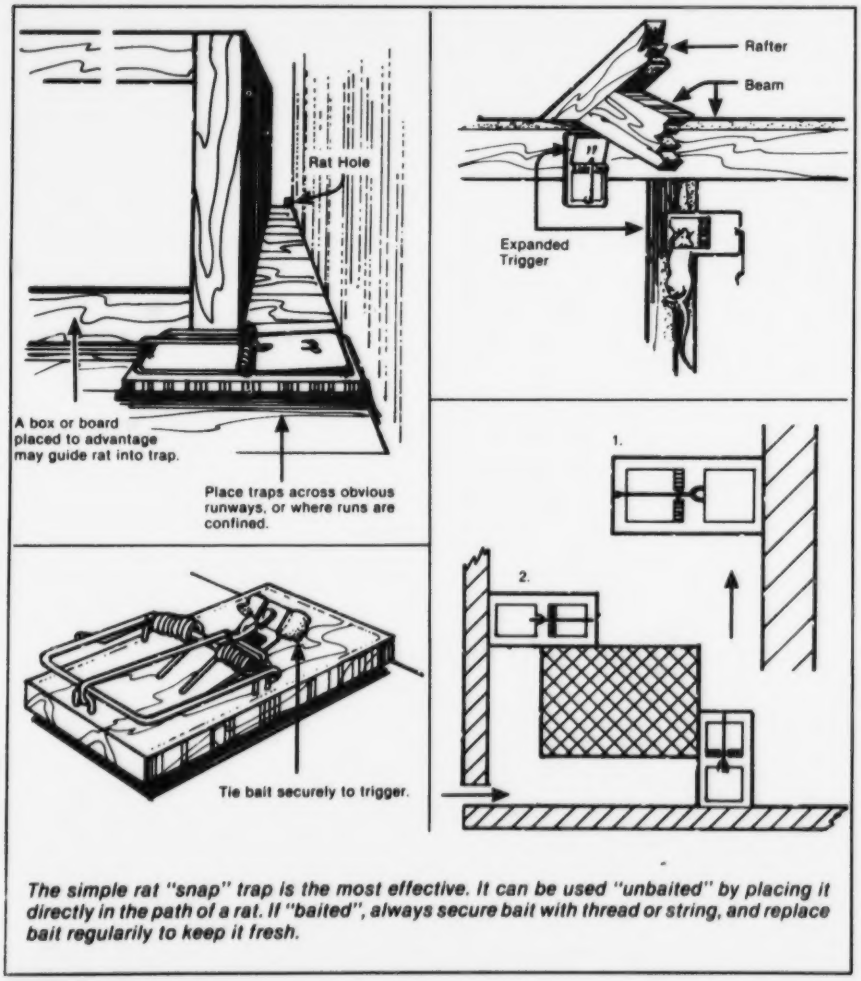
Rat traps can be used unbaited by placing them directly in the path of rodents with the trigger situated to intercept rats coming from either direction (see diagrams below). Expanded treadle-type triggers are available, or a piece of cardboard can be used to enlarge the trigger on a conventional snap trap.

Rats may set traps off without getting caught. If ever a trap is found set off but with no rat caught, you can be sure you will never catch it with a trap again.

The type of bait used to trap Norway rats is very important. Small pieces of hot dogs, bacon or other prepared meats secured tightly to the trigger are the *best choice, but they must be replaced* every day or two to keep them fresh. Peanut butter also works well.

In difficult cases, a trap may be placed slightly below ground level and lightly dusted with fine soil or other fine material to conceal it.

As in the case with poisoning rats, when there is an abundance of food, it makes trapping much more difficult. Before starting a trapping campaign, eliminate as many of the sources of accessible food as possible. Human or dead rat odours on traps do not cause a reduction in catch.



The simple rat "snap" trap is the most effective. It can be used "unbaited" by placing it directly in the path of a rat. If "baited", always secure bait with thread or string, and replace bait regularily to keep it fresh.

GLUE BOARDS

Glue boards are gaining in popularity with PCO's for use where toxicants may not be possible or desirable. They are often used together with, or in addition to, trapping.

It is not recommended that glueboards be fastened down unless they are placed near public places or on rafters or ledges.

Glueboards are simply a base or shallow tray of paper, cardboard or plastic, coated with a non-toxic, sticky substance. They are strategically placed along rat runs where rats are likely to step on the surface in passing. Once the trap has a foot hold, the rodent rarely escapes. They are more successful for mice than Norway rats, but do have some useful applications for indoor situations.

Glueboards have all the advantages that traps have with the additional feature of being safe to use around children and pets. They will not be effective in dusty environments.

OTHER CONTROLS

Ultrasonics

Ultrasonic devices produce high frequency sounds (above the normal hearing range of most humans but well within the range of rats and mice) which are promoted for their ability to rid premises of rodents. Unusually loud sounds, including high frequency sounds, will frighten rats and sometimes cause them to avoid those sounds temporarily, but rarely permanently. They rapidly become accustomed to all known sounds and frequencies, whether fluctuating, variable pitch or used at random intervals. Problems with ultra-sound which limit the usefulness of these devices include:

- It is very directional and does not travel through solid objects or around corners well, thus "shadows" are created.
- The sound does not travel very far as it attenuates (dissipates) rapidly.
- The unit cost of these devices is high and several units are usually required in most applications.
- Much variability between models.
- They must be used with rodenticides to obtain good lasting control. This suggests that with proper use of rodenticides, there are few situations where the additional cost of such a device is warranted.

Electromagnetic Devices

These devices work on a completely different principal than ultrasonics. However, there is no scientific evidence to support any of the claims made by manufactures. For this reason, no electromagnetic device has been granted a registration for rat control purposes in Canada.

Biological Control

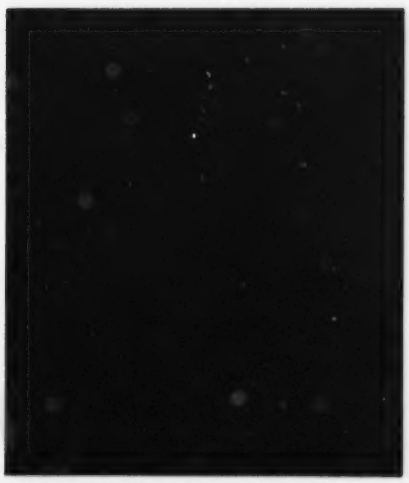
Predators - Rats cannot be effectively controlled by either native or introduced predators, except under highly unusual circumstances. That vertebrate predators can control detrimental rodent species is another long-persisting myth still being taught. The fact is that there is far more evidence that predator numbers are regulated by the number of prey, rather than vice versa. The introduction of rat predators, such as bringing the mongoose into the Hawaiian Islands, rarely helps, and merely produces a new predator pest problem.

Even though house cats, some dogs, and other predators may kill many rats, they usually do not reduce the numbers enough for effective control. Under some circumstances, however, cats may help prevent rats from reinvading property that has been freed of rats. It is not uncommon, however, to find rats living in close association with cats and dogs. They will frequently be living beneath a dog house, and soon learn that they can feed on dog's ration when he is asleep. In fact, many rat problems around homes can be directly correlated with the keeping of pets.

Coyotes, hawks, owls and some members of the skunk family are the most effective predators of rats. Some species live almost entirely on rodents.

SAFETY PRECAUTIONS AND LEGAL IMPLICATIONS

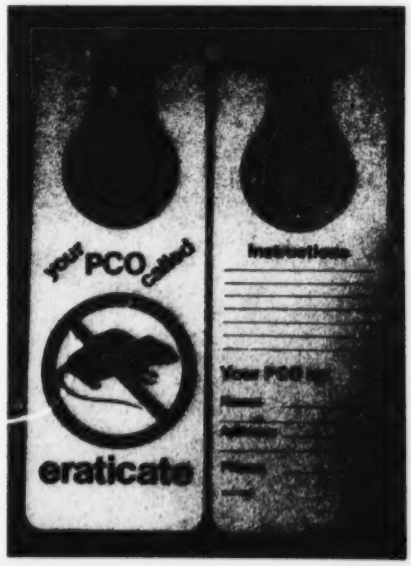
- all rodenticides are potentially dangerous enough to cause death to animals other than rodents, so be sure to place them where they are inaccessible to children, pets, livestock and wildlife.



DO NOT STORE pesticides with foods, feeds, fertilizers or other materials which may become contaminated by the rodenticides.

- records should be kept of all bait placements, including location, quantity, type of poison, dates placed and replenished, and the name of the pest control officer.
- use only those anticoagulants registered for the intended use
- read and follow the rodenticide label instructions
- wherever possible, it is best to buy prepared or ready-to-use baits. Anticoagulants prepared by the pest control officer may not be given or sold to the public.
- all baits should be handled with gloved hands (use rubber gloves).
- store unused bait away from children and food materials, preferably in a locked and well marked location. Access to these materials should be restricted to authorized, responsible individuals.
- vehicles used to transport rodenticides must always be kept locked and have a warning sign clearly visible which indicates chemical storage within.
- Dispose of dead rats immediately and avoid handling rats with bare hands.
- label all bait containers and bait stations with appropriate warnings. Store poisons in original containers bearing registered labels.

Caution: Rodenticides must be handled carefully. The final authority is the registered product label.



PCO's will find the door hanger useful on farm calls when no one is at home.

COMMUNITY CONTROL PROGRAMS

RAT ERADICATION ON THE PRAIRIES

The province of Alberta is essentially rat-free. Government pest control officers (PCO's) monitor an 18-mile wide buffer zone along the Saskatchewan border to prevent westward migration of rats into the province. Rats do not migrate from areas west or north of Alberta and only very occasionally from the sparsely populated southern areas of Montana and Washington states.

In Saskatchewan, local municipal governments and Agricultural District Boards have appointed PCO's in a province-wide campaign to eradicate the Norway rat. This eradication program is presently undergoing several changes and improvements designed to reduce rat populations to the lowest possible level.

The Manitoba government currently has no rat control program. District Ag. Reps. provide extension material to farmers and landowners.

Ongoing interprovincial negotiations are underway which will serve to increase the co-operation between all government agencies involved in rat control. The ultimate objective is to obtain rat-free status for the prairie provinces. Buffer zones, such as that in Alberta will eventually only be necessary along our southern border with the United States (very few rats enter Manitoba from Ontario). As rat densities in these adjacent areas to the south are very low, a buffer zone will require only limited manpower to prevent re-invasion by rats.

CO-OPERATION AT THE LOCAL GOVERNMENT LEVEL

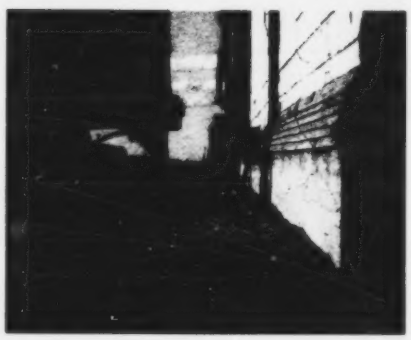
Rats are a community problem and a proper eradication program requires the co-operation of every person within the community. Local government (rural and urban), industry, and private citizens must work together to ensure all potential harbourages and food sources are eliminated; not only on farms, but also on vacant properties, urban areas, garbage disposal sites and elevators.

Encourage your municipality to practice proper sanitary landfill practices and rat control measures at garbage dumps (see "Garbage Removal").

Local officials must demonstrate continuing interest in and support of a model disposal operation by providing adequate financing, by visiting it frequently, and by making it a showplace for the public and visiting officials.

A day's catch in the early days of rat control on the prairies.

If refuse collection is not frequent and regular, householders cannot be expected to store refuse properly. Ordinances and timely enforcement are needed for those who refuse to obey regulations. Carelessness and indifference of any of the people are formidable foes to a successful rodent control program. These attitudes must be fought with a continuous educational effort and with consistent, fair, resolute law-enforcement activity on a continuing basis.



Ensure unused, derelict elevators are free of rats or torn down.

Special ordinances may be required for food and feed processing establishments, feedlots, slaughter houses and other "high risk" areas. Each year, the essentials of rodent control should be taught in the schools to all students. Educational and promotional programs should be presented to community organizations such as Chambers of Commerce and service clubs, and these groups should be invited to sponsor community projects to promote improvements.

For a rat control program to be successful, educational and promotional work must reach the smallest communities and villages. Oftentimes neighbourhood service or improvement clubs will assume leadership.

Pest Control Officers must attend regular training updates to keep abreast of new developments in the rat control program.

Stimulating neighbourhood meetings must be held periodically to gain and to maintain enthusiasm and support. New ideas or "gimmicks" must occasionally be incorporated into motivational efforts to sustain citizen interest. Publicity through mass media (newspapers, radio, television, exhibits, leaflets, etc.) is essential and it is imperative to have their support behind a program such as this.

Finally, rat eradication will involve the support and co-operation of every person living on the prairies. If you find or suspect a rat infestation anywhere in your community, contact your local PCO, fieldman, or Ag. Rep. immediately.

With people working together in a well-organized rat control program, the eradication of rats throughout the prairies no longer has to be an elusive dream.

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